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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/539,624	06/17/2005	Naoya Matsuoka	050340-0190	4578

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EXAMINER	
HAN, KWANG S	

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1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/539,624	MATSUOKA, NAOYA	
	Examiner	Art Unit	
	Kwang Han	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 August 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-17* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

FUEL CELL SYSTEM

Examiner: K. Han SN: 10/539,624 Art Unit: 1795 October 26, 2009

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 21, 2009 has been entered. Claim 6 was amended.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Specification

3. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 103

4. The claim rejection under 35 U.S.C. 103(a) as unpatentable over Mathias et al., Nonobe and Ban et al. on claim 14 is withdrawn, because of Applicant's arguments. New grounds of rejection are presented below.

5. The claim rejection under 35 U.S.C. 103(a) as unpatentable over Mathias et al., Nonobe and Ban et al. on claim 15 is withdrawn, because of Applicant's arguments. New grounds of rejection are presented below.

6. Claims 1, 2, 6, 7, 9, 11, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al. (US 6376111) in view of Busenbender (US 2003/0039870) and Suzuki et al. (US 2001/0010872) is maintained.

Regarding claim 1, Mathias discloses a fuel cell system comprised of the following:

- an anode (18) which contacts the fuel gas (2:30-31) ,
- a cathode (16) which contacts the oxidant gas (2:28-30),
- an electrolyte membrane (14) held between the anode and cathode (Figure 1),
- a moisture adjusted gas generating mechanism (2:54-3:7), and
- a programmable controller (44) (4:7-9).

Mathias discloses the measurement of resistance within the fuel cell assembly to determine the humidity level within the system (3:42-46) but is silent towards the measurement of temperature to control the humidity within the fuel cell and also determine a target humidity based on a temperature of the fuel cells after power generation is halted.

Busenbender teaches a sensor which detects the fuel cell temperature to send a temperature-based control signal to a control system [0014] as part of a system for the benefit of avoiding of freezing water present in a fuel cell during periods of inactivity

[Abstract]. It would have been obvious to one of ordinary skill in the art at the time of invention to use a temperature sensor based control system during periods of inactivity because Busenbender teaches and recognizes the need to avoid freezing of water in a fuel cell during periods of inactivity and low temperature.

Suzuki et al. teaches a control system [0033] which directs dry air to remove residual moisture directly to the fuel cell [0066], and thereby changing the humidity level, in a fuel cell system to prevent freezing [0043, 0048]. It would have been obvious to one of ordinary skill in the art at the time of the invention to controlled modification of the humidity level to a target humidity within Mathias and Busenbender's fuel cell anode or cathode, because Suzuki teaches changing the humidity level in a fuel cell system allows for the prevention of freezing.

Regarding claim 2, Mathias discloses a moisture adjusted gas comprised of humidified fuel gas and humidified oxidant gas (2:54-59).

Regarding claim 6, Mathias discloses a fuel cell system comprised of the following:

- an anode (18) which contacts the fuel gas (2:30-31) ,
- a cathode (16) which contacts the oxidant gas (2:28-30),
- an electrolyte membrane (14) held between the anode and cathode (Figure 1),
- a moisture adjusted gas generating mechanism (2:54-3:7),
- a programmable controller (44) (4:7-9),
- a sensor (42) which detects a wet condition of the fuel cell, and

- the controller (44) is programmed to set the target humidity higher when the wet condition of the fuel cell is drier than a predetermined level of a membrane wet region (4:1-18).

Mathias discloses the measurement of resistance within the fuel cell assembly to determine the humidity level within the system (3:42-46) and the recognition of the humidification to be in a nominal range so the membrane is not too dry or to be flooded (4:1-9) but is silent towards the measurement of temperature to control the humidity within the fuel cell and also determine a target humidity based on a temperature of the fuel cells after power generation is halted.

Busenbender teaches a sensor which detects the fuel cell temperature to send a temperature-based control signal to a control system [0014] as part of a system for the benefit of avoiding of freezing water present in a fuel cell during periods of inactivity [Abstract]. It would have been obvious to one of ordinary skill in the art at the time of invention to use a temperature sensor based control system during periods of inactivity because Busenbender teaches and recognizes the need to avoid freezing of water in a fuel cell during periods of inactivity and low temperature.

Suzuki et al. teaches a control system [0033] which directs dry air to remove residual moisture directly to the fuel cell [0066], and thereby changing the humidity level (point of no condensation), in a fuel cell system to prevent freezing [0043, 0048]. It would have been obvious to one of ordinary skill in the art at the time of the invention to use controlled modification of the humidity level to a target humidity within Mathias and

Busenbender's fuel cell anode or cathode, because Suzuki teaches changing the humidity level in a fuel cell system allows for the prevention of freezing.

Mathias discloses a fuel cell system which comprises a sensor (42) which detects a wet condition of the fuel cell and the controller (44) is programmed to set the target humidity higher when the wet condition of the fuel cell is drier than a predetermined level of a membrane wet region (4:1-18).

Regarding claim 7, Mathias discloses a controller further programmed to modify the target humidity according to the wet condition of the fuel cell which varies during the supply of moisture-adjusted gas and to control the gas generating mechanism such that the humidity of the moisture adjusted gas matches the modified target humidity (4:1-18).

Regarding claim 9, Mathias discloses a sensor (42) which measures electrical resistance between the anode and the cathode (3:42-46).

Regarding claim 11, the teachings of Mathias, Busenbender, and Suzuki as discussed above are herein incorporated. Mathias discloses a sensor which measures the humidity within the fuel cell but is silent towards a sensor to measure the outside temperature.

Busenbender teaches a sensor to measure the outside temperature (122) which is used to provide a signal to the controller to determine when a threshold temperature value has been reached [0037] during periods of system inactivity [Abstract] to avoid freezing of water resident in the system.

Suzuki teaches a sensor to measure the outer temperature used to initiate a mode to stop freezing within the fuel cell once reaching a critical temperature [0043,

0048]. It would have been obvious to one of ordinary skill in the art at the time of the invention to use Busenbender or Suzuki's sensor in Mathias' fuel cell to provide a means to control the moisture-adjusted gas during low temperatures when the fuel cell has been halted to stop freezing within the fuel cells.

Regarding claim 12, Mathias discloses a target humidity during testing for the cathode at 50% relative humidity (5:38-40) and for the anode at 73% relative humidity (5:49-50). Mathias also teaches that the efficiency of a fuel cell is a function of the humidification (6:5-8; 5:38-58).

It would have been obvious to one of ordinary skill in the art at the time of the invention to set the target humidity between 15% and 95% since it has been held that discovering the optimum ranges for a result effective variable such as the target humidity for a fuel cell involves only routine skill in the art in the absence of showing of criticality in the claimed range (MPEP 2144.05). In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

7. Claims 3, 4, 8, 16, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al., Busenbender, and Suzuki et al. as applied to claim 1 above, and further in view of Nonobe (US 6524733) is maintained.

The teachings of Mathias, Busenbender, and Suzuki at discussed above are herein incorporated.

Regarding claim 3, Mathias teaches the humidifier can humidify one or both of the cathode and anode flow channels and the humidifier may be external or comprise a

section of the fuel cell (2:56-64). Busenbender and Suzuki are silent as to having a first and second humidifier.

Nonobe teaches a fuel cell with a humidity control system which uses a fuel gas humidifier (23) and an oxidative gas humidifier (25) to selectively control the humidification levels in both gas channels to stay within a proper range [Abstract]. It would have been obvious to one of ordinary skill in the art at the time of the invention to use Nonobe's first and second humidifier in the fuel cell of Mathias as modified by Busenbender and Suzuki to maintain a specific adjusted humidity for both gas channels to maintain efficiency or prevent freezing.

Regarding claims 4 and 16, Mathias and Busenbender are silent towards having a difference in humidity relative to temperature. Suzuki discloses minimizing humidity as temperature decreases as discussed above but is silent towards increasing humidity with greater temperature.

Nonobe teaches lowering or increasing the vapor pressures of the gas based on the adjustments made by the humidification condition present including temperature(6:25-7:47) to maintain vaporization of water. It would have been obvious to one of ordinary skill in the art at the time of the invention to set the target humidity based on Nonobe's increased or decreased fuel cell temperature during higher or lower humidity levels in the fuel cell of Mathias as modified by Busenbender and Suzuki because Nonobe teaches increasing the vapor pressure of the fuel cell to maintain vaporization of water to prevent flooding of the fuel cell.

Regarding claim 8, Mathias discloses a controller programmed to control the moisture-adjusted gas when the wet condition of the fuel cell has reached a predetermined state of equilibrium (4:45-50).

Nonobe teaches a controller (60) which controls the moisture-adjusted gas generating mechanism (23, 24) based on the temperature of the fuel cell and wet conditions of the fuel cell (5:50-64) and halts the supply of moisture-adjusted gas as required (7:5-14) to increase efficiency of the fuel cell. It would have been obvious to one of ordinary skill in the art at the time of the invention to apply Nonobe's controller in the fuel cell of Mathias as modified by Busenbender, and Suzuki for the benefit of providing halting of moisture-adjusted gas as the temperature and wet conditions of the fuel cell to meet conditions for the greatest efficiency of the fuel cell.

Regarding claim 17, the teachings of Mathias, Busenbender, Suzuki, and Nonobe as discussed above are herein incorporated.

Nonobe teaches the fuel cell system with the moisture-adjusted gas generating mechanism is able to control the condition of humidification of the electrolyte membrane based on the condition of the electrolyte membrane by executing the humidification control routine (8:8-17). It would have been obvious to one of ordinary skill in the art at the time of the invention that the mechanism and process of Nonobe as applied to the fuel cell of Mathias, Busenbender, and Suzuki provides a humidity control for the electrolyte membrane that would have a moisture content with the moisture adjusted gas in equilibrium when it has reached the target humidity.

8. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al., Busenbender and Suzuki et al. as applied to claim 1 above, and further in view of Ban et al. (US 6350536) is maintained.

Regarding claim 5, the teachings of Mathias, Busenbender, and Suzuki as discussed above are herein incorporated. Mathias discloses a controller which halts the supply of moisture-adjusted gas determined by the humidity range within the fuel cell (4:1-18). Busenbender and Suzuki are silent towards stopping a supply of moisture-adjusted gas after a period of time.

Ban teaches a fuel cell system used in a cold environment where the operation of a compressor was continued for a predetermined period of time after the supply of water was interrupted so that the remaining water is discharged as much as possible (1:42-49). It would have been obvious to one of ordinary skill in the art at the time of the invention to apply the halting of a moisture supply after a specified period of time in the fuel cell of Mathias as modified by Busenbender, and Suzuki because Ban teaches it allows for the remaining water in the device to be discharged.

9. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al., Busenbender, and Suzuki et al. as applied to claim 1 above, and further in view of Ban et al. (US 6350536) and Gilbert (US 2003/0170506) is maintained.

Regarding claim 10, the teachings of Mathias, Busenbender, and Suzuki as discussed above are herein incorporated. Mathias further discloses a fuel cell stack (2:63-64) and an inlet and an outlet to the membrane electrode assembly (Figure1) with

a sensor but is silent towards having a first and second sensor at the inlet and outlet respectively.

Ban et al. teaches a humidity sensor (23) placed at the inlet of the fuel cell to detect the wet condition of the processed air at the vicinity of the inlet of the fuel cell to provide a detection signal for when the compressor can be stopped (4:9-14). It would have been obvious to one of ordinary skill in the art at the time of the invention to apply Ban inlet placement of the humidity sensors in the fuel cell of Mathias as modified by Busenbender, and Suzuki for the benefit of knowing when a target humidity has been reached at the inlet of the fuel cell.

Gilbert teaches a humidity sensor placed (48) at the outlet of the fuel cell to detect the wet condition of the exhaust gases at the vicinity of the outlet of the fuel cell [0017, 0018] to gauge the operating conditions of the fuel cell. It would have been obvious to one of ordinary skill in the art at the time of the invention to apply Gilbert's outlet sensor in the fuel cell of Mathias as modified by Busenbender, and Suzuki for the benefit of gauging the operating conditions of the fuel cell. It would further have been obvious to one of ordinary skill in the art at the time of the invention to apply Gilbert's outlet placement of the humidity sensors in combination with the inlet humidity sensor of Ban and further in combination with the controller for the fuel cell of Mathias as modified by Busenbender, and Suzuki for the benefit of knowing when to stop the supply of moisture-adjusted gas as determined by the inlet and out sensors to know when the target humidity has been reached and to know the operating conditions of the fuel cell.

10. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al., Busenbender and Suzuki et al. as applied to claim 1 above, and further in view of Walsh (US 2002/0182466) is maintained.

Regarding claim 13, the teachings of Mathias, Busenbender, and Suzuki as discussed above are herein incorporated. Mathias, Busenbender, and Suzuki are silent towards the target humidity supplied to the anode to be higher than that supplied to the cathode.

Walsh teaches that the flow of gases to the anode and cathode in a fuel cell are at a relative humidity which are maintained at a level to prevent reactant gasses from drying the membranes in the fuel cell and is further dependant upon the operating conditions and water balance concerns adjusted to different temperature and humidity parameters teaching the humidity provided to the fuel cell as result effective variables [0043]. It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the relative humidity to the anode and cathode since it has been held that discovering the optimum ranges for a result effective variable such as relative humidity involves only routine skill in the art in the absence of showing of criticality in the claimed range (MPEP 2144.05). <u>In re Boesch</u>, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

11. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al., Busenbender, Nonobe and Ban et al.

Regarding claim 14, Mathias is directed towards a fuel cell system comprised of the following:

- performs power generation by means of an electrochemical reaction of a fuel gas and an oxidant gas (1:17-20),
- an anode (18) which contacts the fuel gas (2:30-31) ,
- a cathode (16) which contacts the oxidant gas (2:28-30),
- an electrolyte membrane (14) held between the anode and cathode (Figure 1), and
- a means for generating moisture-adjusted gas at an arbitrary humidity (2:54 – 3:7).

Busenbender teaches a sensor which detects the fuel cell temperature to send a temperature-based control signal to a control system [0014] as part of a system for the benefit of avoiding of freezing water present in a fuel cell during periods of inactivity [Abstract]. It would have been obvious to one of ordinary skill in the art at the time of invention to use a control system during periods of inactivity because Busenbender teaches and recognizes the need to avoid freezing of water in a fuel cell during periods of inactivity and low temperature.

Nonobe teaches a controller (60) which controls the moisture-adjusted gas generating mechanism (23, 24) to provide a target humidity based on the temperature of the fuel cell and wet conditions of the fuel cell (5:50-64) and halts the supply of moisture-adjusted gas as required (7:5-14) to increase efficiency of the fuel cell. It would have been obvious to one of ordinary skill in the art at the time of the invention to

apply Nonobe's controller in Mathias' fuel cell for the benefit of providing a target humidity based on the temperature and wet conditions of the fuel cell to provide optimum conditions for efficiency or freezing concerns.

Ban teaches a fuel cell system used in a cold environment where the operation of a compressor was continued for a predetermined period of time after the supply of water was interrupted so that the remaining water is discharged as much as possible (1:42-49). It would have been obvious to one of ordinary skill in the art at the time of the invention to continue supply of a moisture adjusted gas to the fuel cell of Mathias as modified by Nonobe because Ban teaches the continued operation of a device so that the remaining water is discharged as much as possible.

12. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mathias et al., Busenbender, Nonobe and Ban et al.

Regarding claim 15, the teachings of Mathias as discussed above are herein incorporated. Mathias is directed towards a fuel cell system comprised of the following:

- performs power generation by means of an electrochemical reaction of a fuel gas and an oxidant gas (1:17-20),
- an anode (18) which contacts the fuel gas (2:30-31) ,
- a cathode (16) which contacts the oxidant gas (2:28-30),
- an electrolyte membrane (14) held between the anode and cathode (Figure 1),

- a moisture adjusted gas generating mechanism for generating moisture-adjusted gas at an arbitrary humidity (2:54 – 3:7), and
- controlling the gas generating mechanism to supply moisture-adjusted gas to at least one of the anode and cathode (1:46-52; 2:54-59).

Mathias is silent towards providing moisture adjusted gas at a target humidity after power generation is halted.

Busenbender teaches a sensor which detects the fuel cell temperature to send a temperature-based control signal to a control system [0014] as part of a system for the benefit of avoiding of freezing water present in a fuel cell during periods of inactivity [Abstract]. It would have been obvious to one of ordinary skill in the art at the time of invention to use a control system during periods of inactivity because Busenbender teaches and recognizes the need to avoid freezing of water in a fuel cell during periods of inactivity and low temperature.

Nonobe teaches a controller (60) which controls the moisture-adjusted gas generating mechanism (23, 24) to provide a target humidity based on the temperature of the fuel cell and wet conditions of the fuel cell (5:50-64) and halts the supply of moisture-adjusted gas as required (7:5-14) to increase efficiency of the fuel cell. It would have been obvious to one of ordinary skill in the art at the time of the invention to apply Nonobe's controller in Mathias' fuel cell for the benefit of determining a target humidity based on the temperature and wet conditions of the fuel cell to provide optimum conditions for efficiency or freezing concerns.

Ban teaches a fuel cell system used in a cold environment where the operation of a compressor was continued for a predetermined period of time after the supply of water was interrupted so that the remaining water is discharged as much as possible (1:42-49). It would have been obvious to one of ordinary skill in the art at the time of the invention to continue supply of a moisture adjusted gas to the fuel cell of Mathias as modified by Nonobe because Ban teaches a continued operation of a device so that the remaining water is discharged as much as possible.

Response to Arguments

13. Applicant's arguments filed August 28, 2008 have been fully considered but they are not persuasive.

Applicant's principal arguments are:

(a) Mathias, Busenbender, and Suzuki references do not suggest that a target humidity is set to be higher when the wet condition of the fuel cell is drier than a predetermined wet region when the wet condition of the fuel cell is wetter than the predetermined region,

(b) Mathias reference teaches humidity control when the fuel cell is operating but does not teach humidity control after the fuel cells have halted operation.

In response to Applicant's arguments, please consider the following comments:

(a) as discussed in the rejection above, Mathias recognizes the humidification of the fuel cell needs to be in a nominal range so the membrane is not too dry or is flooded by moisture (4:1-9) teaching the humidity to be within a target range,

(b) the Busenbender reference clearly teaches the need for continued monitoring and control of the fuel cell environment during periods of inactivity to prevent freezing. One of ordinary skill in the art would recognize that an inactive system would not generate new moisture but the moisture already present within the system would require continued monitoring to prevent freezing at low temperatures or flooding before renewed operation as taught by Mathias and Busenbender.

Contact/Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kwang Han whose telephone number is (571) 270-5264. The examiner can normally be reached on Monday through Friday 8:00am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dah-Wei Yuan can be reached on (571) 272-1295. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/K. H./
Examiner, Art Unit 1795

/Dah-Wei D. Yuan/
Supervisory Patent Examiner, Art Unit 1795